Health risk assessment of mixtures of pollutants in indoor air using the Maximum Cumulative Ratio (MCR) approach

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Indoor air contains wide range of chemicals as gases, vapours and particles derived from various sources such as infiltration of outdoor air, building materials and different human activities. Children are constantly exposed to multiple substances in classrooms which can result in adverse health effects as they spend significant amount of time in that environment and are more susceptible to such pollutants. It is important to evaluate the toxicity of mixture in order to do the risk assessment. This study aims to explore whether health risks due to indoor air pollution are driven by single substance or are due to simultaneous exposure to various substances by using the Maximum Cumulative Ratio (MCR) approach.

As described by Price and Han (2011), the MCR of the individual's exposure to the pollutant mixture is the ratio of the Hazard Index (HI) of the mixture to the maximum of the Hazard Quotient of the individual components (max HQi). Basically, it requires the knowledge of concentrations of substances in the air mixture together with health based Reference Values (RVs) for those substances. MCR and HI can be used to classify mixtures (Price et al, 2012) into four different groups for which risk management strategies are different. For this study, the reference concentration ($\mu g/m^3$) for each substance was used as a reference value.

Air samples were collected from classrooms of 25 different schools in Brisbane specifically for Volatile organic Compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs) including both in gaseous and particle phase. Analysis was undertaken on the measured concentrations of VOCs and PAHs in about 300 air samples. The MCR analysis found high variability in the proportion of pollutant mixtures regarding their toxicity (from the analysis of samples from first five schools). The fraction of mixtures in these groups varied from school to school (for example from 2.5% in S01 to 75% in S05). Such variations are not only due to the concentration of pollutants but also due to other factors such as number and type of substances identified and selection of RVs.

The calculated MCR values from different air samples would be applied as a tool for the evaluation of mixture of pollutants whether it is of concern for toxicity or not and if so whether the toxicity is driven by single substance or multiple substances. In addition to this, it also provides useful information on pollutant mixture whether it requires further combined risk assessment or single substance assessment is enough.

References

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